Charge correlations and dynamical instabilities in multifragmentation *

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In recent years, it has been suggested that multifragment production can be related to the occurrence of instabilities in the intermediate system produced by heavy ion collisions. Although the scenarios and the models vary, breakup into several *nearly equal-sized* fragments is a common result of instabilities. We report the examination of model independent signatures that would indicate decay into a number of nearly equal-sized fragments by investigating charge correlations from both experimental data and simulations [1].

For comparison with experimental data, and to determine the sensitivity of our analysis, Monte Carlo calculations have been performed. The created events obey two conditions: the sum charge of all fragments is conserved within an adjustable accuracy, and a fragment is produced according to a probability consistent with the experimental finding, that the charge distributions are nearly exponential functions. Furthermore, the simulation allows one to smear out the charge distributions of the individual fragments of an event according to a Gaussian distribution.

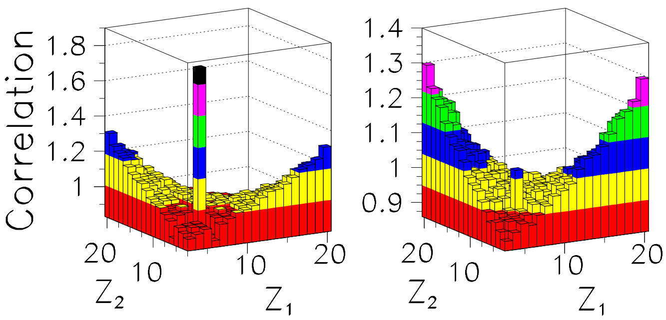

FIG. 1. Two particle charge correlations of IMF's from simulations for $N_{\rm IMF}$=6 plus 1% (left) and 0.1% (right panel) of $Z_{\rm art}$=6.

To demonstrate the sensitivity of our method to breakup configurations producing equal-sized fragments, Fig. 1 shows the results of simulations for the case $N_{\rm IMF} = 6$. Here, a "contamination" of 1% of the events consisting of fragments which all have the size $Z_{\rm art} = 6$ has been added to the data set. The peak produced by these fragments is clearly visible, even if we decrease the yield of equal-sized fragments to only 0.1%. We note that the "background" seen in Fig. 1 is only due to charge conservation. The same analysis used for the simulation has been applied to experimental data of the reaction Xe+Cu at E/A=50 MeV for different $N_{\rm IMF}$ cuts. An enhanced signal for breakup into nearly equal-sized fragments was not observed in *any* of the $N_{\rm IMF}$ bins.

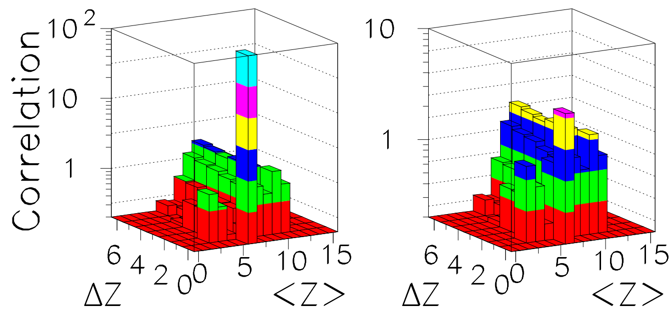

FIG. 2. Higher order charge correlations from the simulations for a system size of 83, $N_{\rm IMF}$ = 6 and widths of ω=0 and ω=2.

To increase the sensitivity of the method, we have also investigated higher order charge correlations [1]. In Fig. 2, we show the results of such an analysis. Here, $\langle Z\rangle$ denotes the average fragment charge of the event, and ΔZ is the standard deviation. The same simulation which has already been shown in Fig. 1 was used. Here, only 0.1% of the events were chosen to have fragments with equal size. We show two cases with a "smearing" width of $\omega = 0$ and $\omega = 2$, respectively. The comparison between the two particle and the higher order charge correlation functions for the same simulations using $\omega = 0$ shows an enhancement of ~20% for the first case (right panel of Fig. 1) while the signal in the second case exceeds the "background" by roughly a factor of 100 (left panel of Fig. 2).

We have also analysed our experimental data for higher order charge correlation. No signals are observed that can be attributed to an enhanced production of nearly equal-sized fragments. This results in an upper limit of breakup events with nearly equal-sized fragments of less than 0.05% if we assume a width $\omega < 3$. Similar results have been obtained for other systems albeit with significantly poorer statistics.

[1] ,* L.G. Moretto *et al.*, Phys. Rev. Lett. **77**, 2634 (1996).